

OPENING THE PLEURA DURING INTERNAL MAMMARY ARTERY HARVESTING: ADVANTAGES AND DISADVANTAGES

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OBJECTIVE: To evaluate the findings of previous studies that opening of the pleura during internal mammary artery (IMA) dissection might be an important factor in increasing the operative morbidity.

DESIGN: A randomized control trial.

SETTING: A university hospital.

PATIENTS: Two hundred and eighty consecutive patients with no significant pulmonary disease.

INTERVENTION: Harvesting of the IMA with (130 patients) or without (150 patients) opening the pleura.

MAIN OUTCOME MEASURES: Comparison of the incidence of pleural effusion, cardiac tamponade, postoperative respiratory complications and the hospital stay.

RESULTS: Pleural effusion occurred more often in the patients who had opening of the pleura (20% versus 5%); however, none of the patients required tapping. Postoperative bleeding with cardiac tamponade occurred in five patients in the closed pleura group. Six patients in the open pleura group had postoperative bleeding but without tamponade. The average postoperative hospital stay was 7 days for both groups. No significant differences were recorded in postoperative respiratory complications.

CONCLUSIONS: Opening of the pleura during IMA harvesting does not increase the operative morbidity. It may have other advantages and is recommended in most cases of IMA harvesting.

OBJECTIF : Évaluer les résultats d'études précédentes selon lesquelles l'ouverture de la plèvre au cours d'une dissection de l'artère mammaire interne (AMI) pourrait jouer un rôle important dans la hausse de la morbidité opératoire.

CONCEPTION : Étude témoin randomisée.

CONTEXTE : Hôpital universitaire.

PATIENTS : Deux cent quatre-vingts patients consécutifs sans pneumopathie significative.

INTERVENTION : Prélèvement de l'AMI avec (130 patients) ou sans (150 patients) ouverture de la plèvre.

PRINCIPALES MESURES DES RÉSULTATS : Comparaison de l'incidence d'épanchements pleuraux, de tamponades cardiaques, de complications respiratoires postopératoires et du séjour à l'hôpital.

RÉSULTATS : Les épanchements pleuraux ont été plus fréquents chez les patients dont on a ouvert la plèvre (20 % contre 5 %); cependant, aucun des patients n'a eu besoin de ponction. Il y a eu saignement postopératoire et tamponade cardiaque chez cinq patients du groupe de ceux dont la plèvre n'a pas été ouverte. On a constaté un saignement postopératoire mais sans tamponade chez six patients du groupe de ceux dont la plèvre a été ouverte. Le séjour à l'hôpital après l'intervention a duré en moyenne 7 jours chez les deux groupes. On n'a enregistré aucun écart important au niveau des complications respiratoires postopératoires.

CONCLUSIONS : L'ouverture de la plèvre au cours du prélèvement de l'AMI n'augmente pas la morbidité opératoire. Elle peut présenter d'autres avantages et elle est recommandée dans la plupart des cas de prélèvement de l'AMI.

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The internal mammary artery (IMA) has become an important graft material in coronary artery bypass grafting. It has proved to be the most long-lasting of the available graft materials¹ and is now used routinely in many centres. However, whether pleurotomy should be part of the harvesting procedure has been controversial since the technique was first described.² Several studies³⁻⁵ reported that opening the pleura to harvest the IMA was associated with an increased incidence of postoperative pulmonary complications. This has not been our experience. We undertook this study to compare the complication rates of two groups of patients randomized to undergo coronary artery bypass grafting surgery with or without pleurotomy.

PATIENTS AND METHODS

Two hundred and eighty consecutive patients suffering from coronary artery occlusion underwent coronary artery bypass grafting at the Victoria General Hospital, Halifax. From 2 to 5 vessels (mean 3.2 vessels) were bypassed per patient. All procedures were elective, and each patient required at least one IMA pedicle graft during the operation.

The patients were screened for pulmonary diseases before operation. Any who had history of major lung disease such as asthma, chronic obstructive airway disease or emphysema were excluded from the study. In patients thought to have pulmonary disease on clinical examination, pulmonary function tests were performed. If the forced vital capacity (FVC) or the forced expiratory volume in 1 second (FEV₁) was less than 80% of the predicted value, the patient was also excluded.

Patients were prospectively randomized to undergo either extrapleural mo-

bilization of the IMA pedicle, in which the pleura was kept closed during the entire procedure (group 1, 130 patients) or pleurotomy and mobilization of the IMA pedicle together with the endothoracic fascia surrounding it (group 2, 150 patients). The randomization was carried out on an alternate consecutive basis (open group, closed group, open group and so on). Perfect randomization could not be achieved, however, because sometimes it was technically impossible to harvest the IMA without opening the pleura. This resulted in more cases in the open pleura group.

Systemic cooling (body temperature at 32 °C) during cardiopulmonary bypass was achieved and myocardial protection provided with intermittent doses of cold blood cardioplegic solution at 10 °C. No topical cooling was used. The IMA was mobilized with electrocautery, and the side branches were clipped with hemoclips before dividing. Postoperatively, the two groups of patients were followed up, and the following parameters were noted and compared:

- Pleural effusion. The chest films obtained on the day of surgery and on the 3rd postoperative day were compared. The number of pleural effusions in each group was noted. The

extent of pleural effusion was divided into three categories: mild — obliteration of the costophrenic angle; moderate — occupying up to one-third of the lung field; severe — occupying more than one-third of the lung field.

- Pulmonary complications. The number of cases of pneumonia and significant atelectasis (diagnosed radiologically) and the length of ventilatory support were recorded for each patient.

- Cardiac tamponade. The number of cases of cardiac tamponade that required surgical intervention in each group was noted.

- Postoperative hospital stay. The average postoperative hospital stay in days was calculated for each group.

The results from each group have been reported as the arithmetic mean and standard error of the mean (mean [SEM]). Data were analysed by the χ^2 test. Differences were considered significant at a probability value of less than 0.05.

RESULTS

Although the pleura can be kept intact easily in most cases, some patients with large lungs or a short IMA had to have the pleura opened to increase the length of the IMA pedicle, thus

Table I

Demographic Variables in Patients Who Underwent Internal Mammary Artery Harvesting by Closed (Group 1) and Open (Group 2) Pleura Techniques

Variable	Group 1, n = 130	Group 2, n = 150
Age, yr*	56.1 (1.51)	55.9 (1.69)
Sex, M/F	85/45	93/57
Ejection fraction, %*	62.3 (1.51)	59.1 (1.48)
Clamp time, min*	49.2 (1.30)	47.5 (0.95)
Active smoker, no. (%) of patients	29 (22)	47 (31)
Vessels bypassed, no.*	3.1 (0.23)	3.4 (0.63)
Pump time, min*	74.6 (1.21)	79.2 (1.9)

*Figures are mean (and standard error).

leading to more patients in group 2 than in group 1. The two groups were comparable with respect to age, sex, ejection fraction, clamp time, smoking history, number of vessels bypassed and pump time (Table I).

Complications (Table II)

- Pleural effusion. None of the patients suffered severe effusion and no effusion required tapping in either group. Mild to moderate effusion was noted in 7 group 1 patients (5%) and 30 group 2 patients (20%) ($p < 0.001$).

- Pulmonary complications. Based on the absence of clinical and radiologic findings that indicated the need for ventilatory support or antibiotic therapy, no patient in either group had significant atelectasis or pneumonia. The ventilator was required for periods ranging from 8 to 72 hours (mean 20 hours) in group 1 and 8 to 80 hours (mean 18 hours) in group 2. There was no significant difference between the two groups.

- Cardiac tamponade and postoperative bleeding. Five patients in group 1 had cardiac tamponade postoperatively. They all had tachycardia,

low cardiac output and low systemic blood pressure. Six patients in group 2 had significant postoperative bleeding without cardiac tamponade. Their cardiac output and blood pressure remained stable. All these patients had evacuation of the hematoma and control of bleeding. One patient had a leak from a distal graft anastomosis, but in the other 10 patients no specific bleeding site was identified. No significant difference was noted between the two groups in regard to the incidence of postoperative bleeding ($p > 0.05$); however, it is important to note that no patient in group 2 had cardiac tamponade.

- Postoperative hospital stay. No significant difference was noted between the two groups with respect to the length of postoperative hospital stay (group 1, 6 to 11 days [mean 7 days], group 2, 6 to 10 days [mean 7 days]).

DISCUSSION

The use of the IMA as a conduit for coronary artery bypass grafting is widely accepted. It has proved superior to vein graft in terms of long-term

patency. Controversy remains, however, as to whether opening the pleura during harvesting of the IMA leads to an increase in the complication rate. The difference between earlier studies³⁻⁵ and our study was the use in earlier studies of topical cooling with ice or cold solution. We believe that direct tissue contact with cold may have adverse local effects, causing phrenic nerve dysfunction, leading to an increase in the rate of local complications.

Another study⁶ showed that there was a significant reduction in FVC and FEV₁ even with the pleura closed but that the FVC and FEV₁ were further reduced when the pleura was opened. Unfortunately, the authors did not mention whether topical cooling was used. Although there is no question that opening the pleura causes further reduction in FVC and FEV₁, whether this will translate into significantly higher postoperative morbidity is not so clear.

There were two significant differences between the two groups regarding the postoperative complication rate and outcome. The first was a higher rate of pleural effusion in group 2. This was more or less expected, given that the pleura was opened and any fluid from the mediastinum will tend to run down and accumulate in the pleural space. However, all pleural effusions were either mild or moderate and did not seem to have any significant clinical effect. This finding was confirmed by the fact that none of the effusions needed drainage, no significant atelectasis or pneumonia was found and there was no difference between the duration of ventilation in the two groups. The second difference was the absence of cardiac tamponade in group 2 patients even though six patients had significant postoperative bleeding. Opening of the pleura and accumulation of

Table II

Postoperative Complications

Complication	Group 1, <i>n</i> = 130	Group 2, <i>n</i> = 150
Pleural effusion, no. (%) of patients		
Mild to moderate*	7 (5)	30 (20)
Severe	0	0
Significant atelectasis or pneumonia	0	0
Ventilation requirement, h*	20.4 (1.48)	18.3 (1.26)
Bleeding, no. (%) of patients	5 (4)	6 (4)
Cardiac tamponade, no. (%) of patients†	5 (4)	0
Postoperative hospital stay, d*	7.2 (0.93)	7.1 (1.72)
Perioperative myocardial infarction		
Non-Q-wave, no. (%) of patients†	5 (4)	3 (2)
Q-wave, no. (%) of patients†	1 (0.8)	2 (1.3)

*Figures are mean (and standard error).

†Significant difference ($p < 0.05$)

fluid in the pleural space may be advantageous: the pressure effect of a comparatively small volume of blood in the mediastinum led to cardiac tamponade, whereas, when the pleura was opened, the same amount of bleeding was tolerated without cardiac tamponade because of drainage into the much larger pleural cavity. Thus, opening the pleura may prevent the sudden onset of tamponade, allowing re-exploration with the patient in a more stable condition.

There are other advantages of opening the pleura in IMA mobilization: in a closed pleura situation, the lung may push on the IMA pedicle thereby decreasing the length of artery available. This may lead to overstretching and tension on the anastomosis. In the case of repeat sternotomy, the IMA pedicle will be in danger of being injured. In contrast, by opening the pleura, the IMA pedi-

cle will come to lie under the lung and away from the sternum.

CONCLUSIONS

This study has shown that opening the pleura during IMA harvesting does not increase the postoperative morbidity. In contrast it may protect the patient from sudden cardiac tamponade in the event of severe hemorrhage. It also has the advantage of preventing overstretching of the IMA by giving it the shortest and the safest lie along its course. Therefore, opening the pleura during IMA harvesting is recommended when the length or the lie of the artery is in question.

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